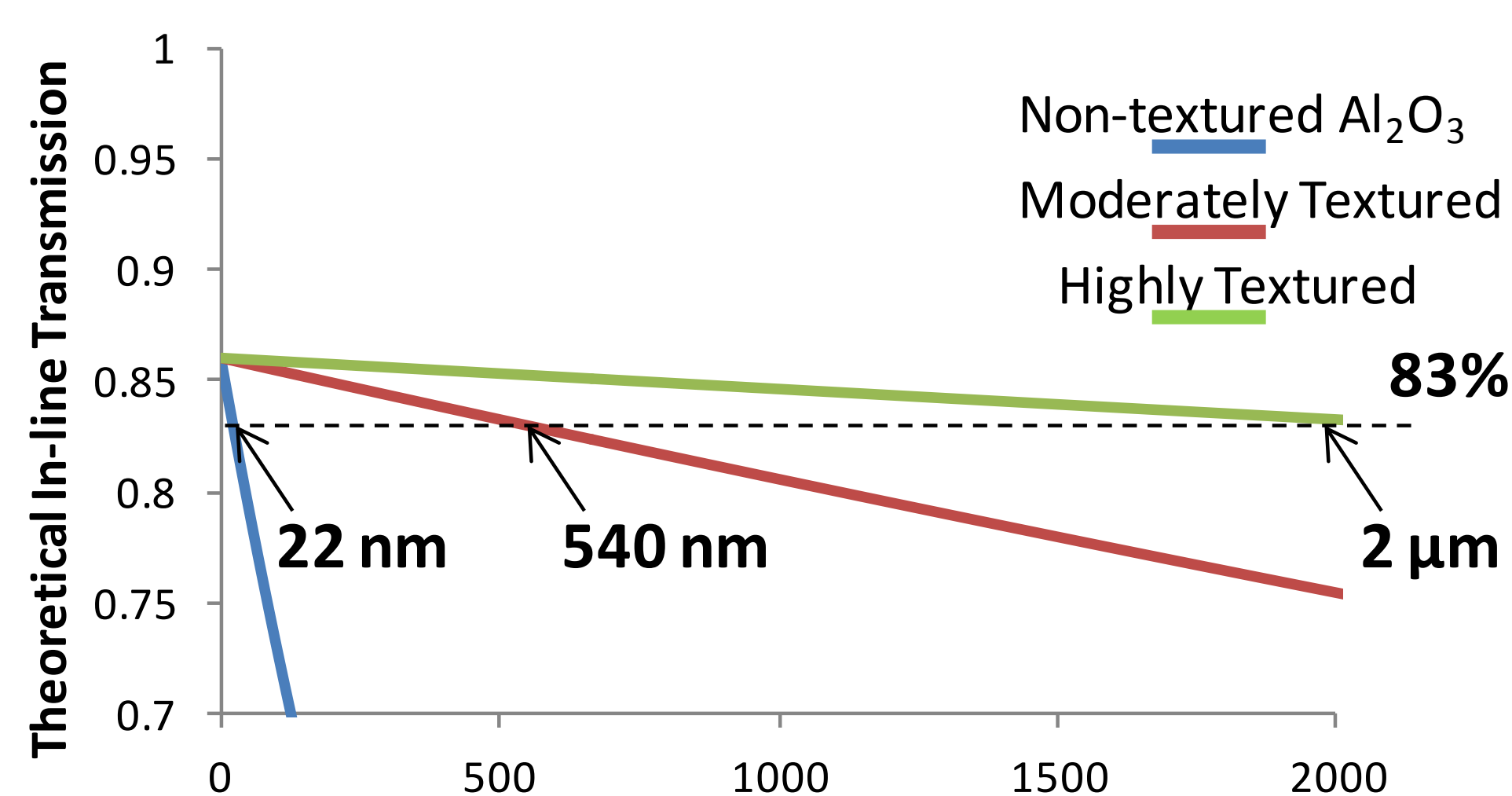


S&T Campaign: Materials Research Manufacturing Science Energy Coupled-to-Matter

Victoria L. Blair
(410) 306-4947
victoria.l.blair3.civ@mail.mil

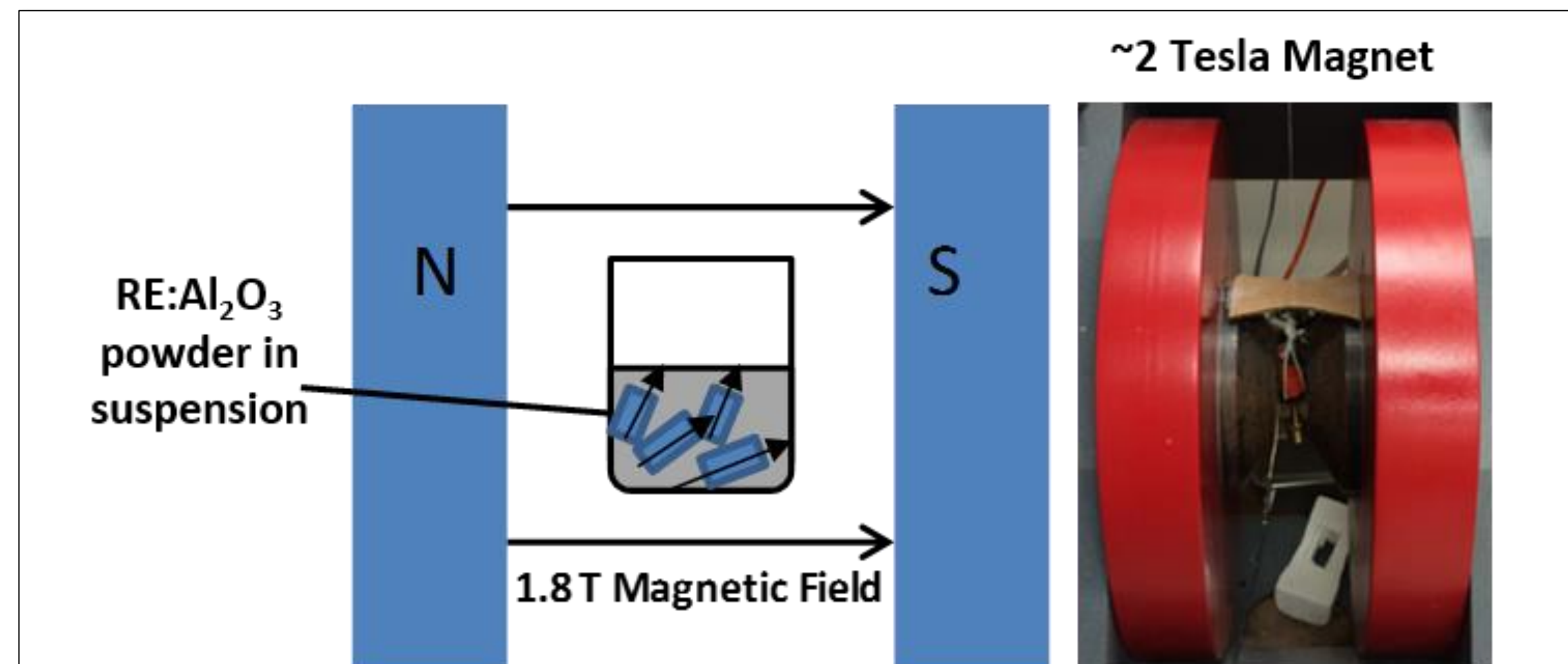
Research Objective

- Gain an understanding of the effects of external field-based processing on microstructural development through experiments and modeling.
- Develop an understanding in the physics of material interaction during processing with applied external fields.

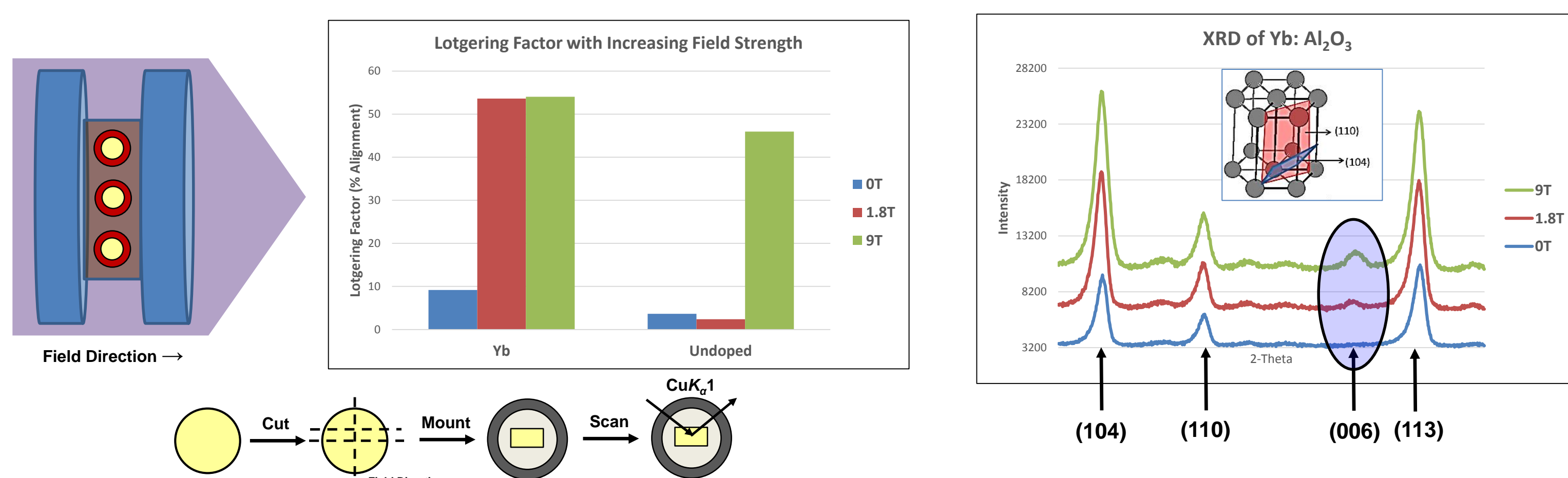


[adapted from Apetz (2004)]

Use both small grains ($\sim 0.5\mu\text{m}$) and moderate level of particle orientation (texture) to achieve transparency.



Orient particles in low viscosity suspension under 2T or greater magnetic field.



Proof of concept measurements with epoxy show particle orientation of $\sim 50\%$ when doped with RE.

Challenges

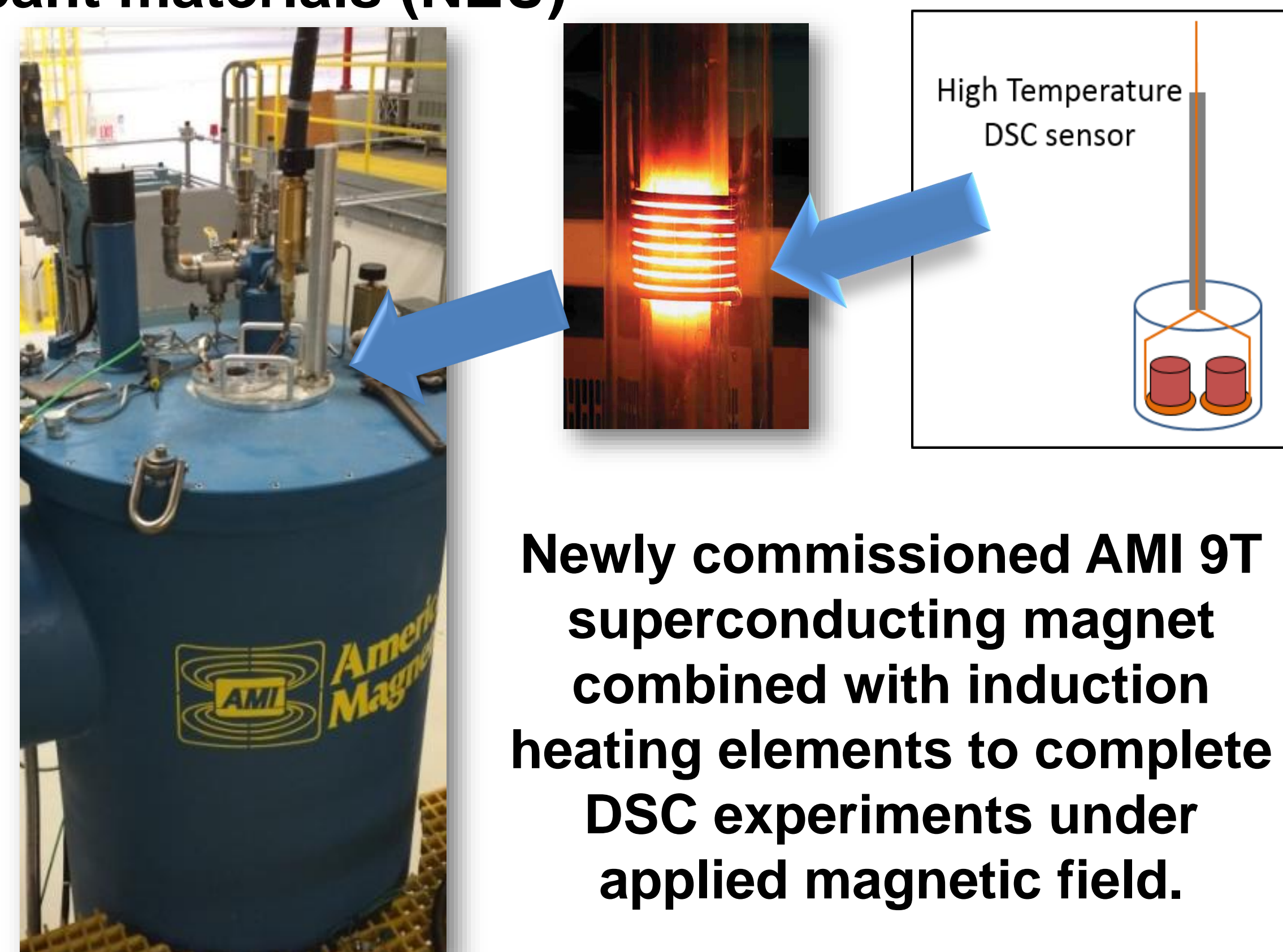
- Using externally-applied fields to induce crystallographic texturing, and hence increase optical transparency of rare-earth doped alumina
- For transparency: high density, small grains, crystallographic texture
- No model to date on effect of EM fields on RE: Al_2O_3

ARL Facilities and Capabilities Available to Support Collaborative Research

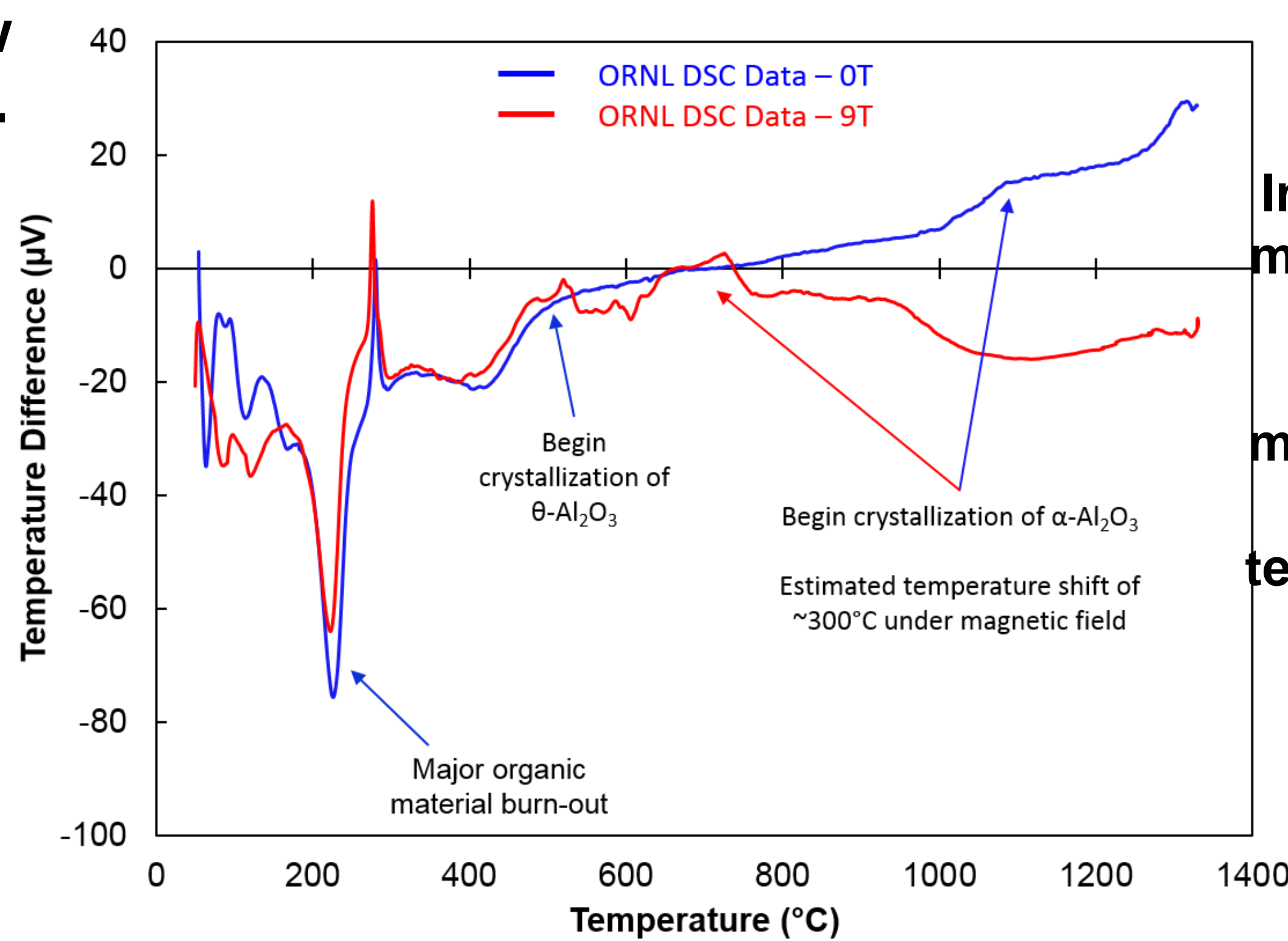
- 9T magnet with induction heating (2200°C) – in progress
- Single mode microwave (2.45 GHz & 5.8 GHz) – in progress
- SEDD: Thermal reflectance, fluorescence
- Meso-scale modeling: ThermoCalc, COMSOL
- Atomic-scale modeling: DFT structure calculations

Complementary Expertise / Facilities / Capabilities Sought in Collaboration

- Microwave processing facility at Penn State University
- High magnetic field laboratory at Oak Ridge National Lab
- Intra-ARL: SEDD
- Other suggestions for innovative research approaches: high magnetic fields (NHMFL), new dopant materials (NEU)



Newly commissioned AMI 9T superconducting magnet combined with induction heating elements to complete DSC experiments under applied magnetic field.



Incorporating a high magnetic field during calcination of precursor Al_2O_3 material can lead to a change in the temperature on-set of crystallization.